

WHAT IS CLAIMED IS:

1. A process for making an extruded soft foam having an Asker C hardness of less than about 65, which process comprises;

5 (I) forming a melt polymer material comprising;

(A) one or more alkenyl aromatic polymers, and wherein at least one of said alkenyl aromatic polymers has a molecular weight (M_w) of from about 100,000 to about 500,000; and

10 (B) one or more substantially random interpolymers having an I_2 of about 0.1 to about 50 g/10 min, an M_w/M_n of about 1.5 to about 20,; comprising;

(1) polymer units derived from;

(a) at least one vinyl or vinylidene aromatic monomer,
or

15 (b) at least one hindered aliphatic or cycloaliphatic vinyl or vinylidene monomer, or

(c) a combination of at least one aromatic vinyl or vinylidene monomer and at least one hindered aliphatic or cycloaliphatic vinyl or vinylidene monomer, and

20 (2) polymer units derived from at least one of ethylene and/or a C_{3-20} α -olefin; and

(3) optionally polymer units derived from one or more of ethylenically unsaturated polymerizable monomers other than those derived from (1) and (2); and

25 (C) optionally, one or more nucleating agents and

(D) optionally, one or more other additives; and

(II) incorporating into said melt polymer material at an elevated pressure to form a foamable gel

30 (E) one or more blowing agents present in a total amount of from about 0.4 to about 5.0 gram-moles per kilogram (based on the combined

weight of Components A and B);

(III) cooling said foamable gel to an optimum temperature; and extrude said foamable gel from Step III either

- (a) through a die to a region of lower pressure to form a foam or,
- (b) into a holding zone maintained at a temperature and pressure which does not allow the gel to foam, the holding zone having an outlet die defining an orifice opening into a zone of lower pressure at which the gel foams, and an openable gate closing the die orifice; periodically opening the gate; substantially concurrently applying mechanical pressure by a movable ram on the gel to eject it from the holding zone through the die orifice into the zone of lower pressure, at a rate greater than that at which substantial foaming in the die orifice occurs and less than that at which substantial irregularities in cross-sectional area or shape occurs; and permitting the ejected gel to expand unrestrained in at least one dimension to produce the foam structure.

2. The process of Claim 1 wherein the foamable gel from step (II) is cooled to an optimum temperature at which foaming does not occur and then extruded through a die to form an essentially continuous expandable thermoplastic strand which is pelletized to form expandable thermoplastic beads.
3. The process of Claim 1 wherein in step (IV) said foamable gel is extruded through a die to form essentially continuous expanded thermoplastic strands which are converted to foam beads by cutting at the die face and then allowed to expand.
4. A process for making a soft foam having an Asker C hardness of less than about 65 in the form of thermoplastic foam beads, which process comprises;
 - (I) forming a melt polymer material comprising;
 - (A) one or more alkenyl aromatic polymers, and wherein at least one of said alkenyl aromatic polymers has a molecular weight (M_w) of from about 100,000 to about 500,000; and

(B) one or more substantially random interpolymers having an I_2 of about 0.1 to about 50 g/10 min, an M_w/M_n of about 1.5 to about 20, comprising;

(1) polymer units derived from;

(a) at least one vinyl or vinylidene aromatic monomer,

or

(b) at least one hindered aliphatic or cycloaliphatic vinyl or vinylidene monomer, or

(c) a combination of at least one aromatic vinyl or vinylidene monomer and at least one hindered aliphatic or cycloaliphatic vinyl or vinylidene monomer, and

(2) polymer units derived from at least one of ethylene and/or a C_{3-20} α -olefin; and

(3) optionally polymer units derived from one or more of ethylenically unsaturated polymerizable monomers other than those derived from (1) and (2); and

(C) optionally, one or more nucleating agents; and

(D) optionally, one or more other additives; and

(II) cooling and granulating the product from step I to form discrete resin particles; and

(III) suspending said resin particles in a liquid medium in which they are substantially insoluble;

(IV) incorporating into the suspension formed in Step III at an elevated pressure and temperature in an autoclave or other pressure vessel;

(E) one or more blowing agents present in a total amount of from about 0.4 to about 5.0 gram-moles per kilogram (based on the combined weight of Components A and B); and

(V) rapidly discharging the product formed in Step IV into the atmosphere, or a region of reduced pressure, to form foam beads.

5. A process for making a soft foam having an Asker C hardness of less than about 65 in the form of thermoplastic foam beads, which comprises;

(I) impregnation of styrene monomer into suspended pellets of one or more substantially random interpolymer(s) in a vessel at elevated temperature in the presence of a peroxide initiator to form a grafted polymer of polystyrene with the substantially random polymer;

(II) impregnation of the product of step I with one or more blowing agents present in a total amount of from about 0.4 to about 5.0 gram-moles per kilogram (based on the weight of the grafted polymer formed in Step I);

(III) cooling and discharging the product from step II to form unexpanded beads; and

(IV) expanding and molding the beads of step III to form a foam;

wherein said grafted polymer formed in step I comprises;

(A) one or more alkenyl aromatic polymers, and wherein at least one of said alkenyl aromatic polymers has a molecular weight (M_w) of from about 100,000 to about 500,000; and

(B) one or more substantially random interpolymers having an I_2 of about 0.1 to about 50 g/10 min, an M_w/M_n of about 1.5 to about 20, comprising;

(1) polymer units derived from;

(a) at least one vinyl or vinylidene aromatic monomer,
or

(b) at least one hindered aliphatic or cycloaliphatic vinyl or vinylidene monomer, or

(c) a combination of at least one aromatic vinyl or vinylidene monomer and at least one hindered aliphatic or cycloaliphatic vinyl or vinylidene monomer, and

(2) polymer units derived from at least one of ethylene and/or a C_{3-20} α -olefin; and

- (3) optionally, polymer units derived from one or more of ethylenically unsaturated polymerizable monomers other than those derived from (1) and (2); and
- (C) optionally, one or more nucleating agents; and
- (D) optionally, one or more other additives.

6. A soft foam having an Asker C hardness of less than about 65, comprising;

- (A) one or more alkenyl aromatic polymers, and wherein at least one of said alkenyl aromatic polymers has a molecular weight (M_w) of from about 100,000 to about 500,000; and
- (B) one or more substantially random interpolymers having an I_2 of about 0.1 to about 50 g/10 min, an M_w/M_n of about 1.5 to about 20; comprising;
- (1) polymer units derived from;
- (a) at least one vinyl or vinylidene aromatic monomer, or
- (b) at least one hindered aliphatic or cycloaliphatic vinyl or vinylidene monomer, or
- (c) a combination of at least one aromatic vinyl or vinylidene monomer and at least one hindered aliphatic or cycloaliphatic vinyl or vinylidene monomer, and
- (2) polymer units derived from at least one of ethylene and/or a C_{3-20} α -olefin; and
- (3) optionally, polymer units derived from one or more of ethylenically unsaturated polymerizable monomers other than those derived from (1) and (2); and
- (C) optionally, one or more nucleating agents and
- (D) optionally, one or more other additives; and
- (E) one or more blowing agents present in a total amount of from about 0.4 to about 5.0 gram-moles per kilogram (based on the combined

weight of Components A and B).

7. An acoustical insulation foam having, either with or without elastification, an Asker C hardness of less than about 65, a density of about 5 to about 150 kg/m³, a cell size of about 0.05 to about 15 mm, an open cell content of 0 to about 100 volume percent, a thickness of about 1 to about 200 mm, and a width of about 100 to about 3000 mm; comprising;

(A) from 20 to 85 percent by weight (based on the combined weights of Component A and B) of one or more alkenyl aromatic polymers, and wherein at least one of said alkenyl aromatic polymers has a molecular weight (M_w) of from 100,000 to 500,000; and

(B) from 15 to 80 percent by weight (based on the combined weight of Components A and B) of one or more substantially random interpolymers and

(C) optionally, one or more nucleating agents and

(D) optionally, one or more other additives; and

(F) one or more blowing agents present in a total amount of from 0.4 to 5.0 gram-moles per kilogram (based on the combined weight of Components A and B); and

wherein said foam (either with or without elastification) has a dynamic modulus from about 100 to about 2000 KPa, and a damping ratio of greater than about 10.

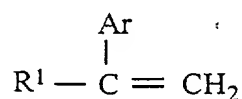
8. The acoustical insulation foam of Claim 7 having, either with or without elastification, an Asker C hardness of less than about 60, a density of about 6 to about 100 kg/m³, a cell size of about 0.1 to about 10 mm, an open cell content of from about 10 to about 95 volume percent, a thickness of about 1.5 to about 100 mm, and a width of about 250 to about 2500 mm; and wherein

A) in Component (A), said at least one alkenyl aromatic polymer has greater than 50 percent by weight alkenyl aromatic monomeric units, has a molecular weight (M_w) of from about 120,000 to about 350,000 and is

present in an amount of from about 30 to about 80 percent by weight (based on the combined weight of Components A and B);

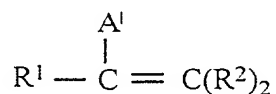
- B) said substantially random interpolymers, Component (B), has an I_2 of about 0.3 to about 30 g/10 min and an M_w/M_n of about 1.8 to about 10; is present in an amount of from about 20 to about 70 percent by weight (based on the combined weight of Components A and B); and comprises
- (1) from about 10 to about 43 mol % of polymer units derived from;

- (a) said vinyl or vinylidene aromatic monomer represented by the following formula;



wherein R^1 is selected from the group of radicals consisting of hydrogen and alkyl radicals containing three carbons or less, and Ar is a phenyl group or a phenyl group substituted with from 1 to 5 substituents selected from the group consisting of halo, C_{1-4} -alkyl, and C_{1-4} -haloalkyl; or

- (b) said sterically hindered aliphatic or cycloaliphatic vinyl or vinylidene monomer is represented by the following general formula;



wherein A^1 is a sterically bulky, aliphatic or cycloaliphatic substituent of up to 20 carbons, R^1 is selected from the group of radicals consisting of hydrogen and alkyl radicals containing from 1 to about 4 carbon atoms, preferably hydrogen or methyl; each R^2 is independently selected from the group of radicals consisting of hydrogen and alkyl radicals containing from 1 to about 4 carbon atoms, preferably hydrogen or methyl; or alternatively R^1 and A^1 together form a ring system; or

c) a combination of a and b; and

(2) from about 57 to about 90 mol % of polymer units derived from ethylene and/or said α -olefin which comprises at least one of propylene, 4-methyl-1-pentene, butene-1, hexene-1 or octene-1; and

(3) said ethylenically unsaturated polymerizable monomers other than those derived from (1) and (2) comprises norbornene, or a C_{1-10} alkyl or C_{6-10} aryl substituted norbornene; and

(C) said nucleating agent, if present, Component (C), comprises one or more of calcium carbonate, talc, clay, silica, barium stearate, diatomaceous earth, mixtures of citric acid and sodium bicarbonate; and

(D) said additive, if present, Component (D), comprises one or more of inorganic fillers, pigments, antioxidants, acid scavengers, ultraviolet absorbers, flame retardants, processing aids, extrusion aids, permeability modifiers, antistatic agents, and other thermoplastic polymers;

(G) (E) said blowing agent, Component (E), is present in a total amount of from about 0.6 to about 3.0 g-moles/kg (based on the combined weight of Components A and B), and comprises one or more of inorganic blowing agent(s), organic blowing agent(s), and/or chemical blowing agent(s); and

wherein said foam (either with or without elastification) has a dynamic modulus from about 100 to about 1000 Kpa, and a damping ratio of greater than about 11.

9. The acoustical insulation foam of Claim 7 having, either with or without elastification, an Asker C hardness of less than about 55, a density of about 10 to about 50 kg/m³, a cell size of about 0.3 to about 2 mm, an open cell content of from about 20 to about 90 volume percent, a thickness of about 2 to about 50 mm, and a width of about 500 to about 2000 mm; and wherein

(A) in Component (A), said at least one alkenyl aromatic polymer has greater than 70 percent by weight alkenyl aromatic monomeric units, has a

molecular weight (M_w) of from about 130,000 to about 325,000, a molecular weight distribution, (M_w/M_n) of from about 2 to about 7, and is present in an amount of from about 35 to about 70 percent by weight (based on the combined weight of Components A and B);

(B) said substantially random interpolmer, Component (B), has an I_2 of about 0.5 to about 10 g/10 min and an M_w/M_n from about 2 to about 5, is present in an amount from about 30 to about 65 wt % (based on the combined weight of Components A and B) and comprises

(1) from about 13 to about 40 mol % of polymer units derived from;

a) said vinyl aromatic monomer which comprises styrene, α -methyl styrene, ortho-, meta-, and para-methylstyrene, and the ring halogenated styrenes, or

b) said aliphatic or cycloaliphatic vinyl or vinylidene monomers which comprises 5-ethylidene-2-norbornene or 1-vinylcyclo-hexene, 3-vinylcyclo-hexene, and 4-vinylcyclohexene; or

c) a combination of a and b; and

(2) from about 60 to about 87 mol % of polymer units derived from ethylene, or ethylene and said α -olefin, which comprises ethylene, or ethylene and at least one of propylene, 4-methyl-1-pentene, butene-1, hexene-1 or octene-1; and

(3) said ethylenically unsaturated polymerizable monomers other than those derived from (1) and (2) is norbornene; and

(C) said nucleating agent, if present, Component (C), comprises one or more of talc, and mixtures of citric acid and sodium bicarbonate;

(D) said additive, if present, Component (D), comprises one or more of carbon black, titanium dioxide, graphite, flame retardants, and other thermoplastic polymers; and

(E) said blowing agent, Component (E), is present in a total amount of from about 0.8 to about 2.5 gram-moles per kilogram (based on the combined weight of Components A and B) comprising one or more of, nitrogen,

sulfur hexafluoride (SF₆), argon, carbon dioxide, water, air and helium, methane, ethane, propane, n-butane, isobutane, n-pentane, isopentane, neopentane, cyclopentane, methanol, ethanol, n-propanol, and isopropanol, methyl fluoride, perfluoromethane, ethyl fluoride,), 1,1-difluoroethane (HFC-152a), fluoroethane (HFC-161), 1,1,1-trifluoroethane (HFC-143a), 1,1,1,2-tetrafluoroethane (HFC-134a), pentafluoroethane (HFC-125), 1,1,2,2 tetrafluoroethane (HFC-134), 1,1,1,3,3-pentafluoropropane, difluoromethane (HFC-32), perfluoroethane, 2,2-difluoropropane, 1,1,1-trifluoropropane, perfluoropropane, dichloropropane, difluoropropane, perfluorobutane, perfluorocyclobutane, methyl chloride, methylene chloride, ethyl chloride, 1,1,1-trichloro-ethane, 1,1-dichloro-1-fluoroethane (HCFC-141b), 1-chloro-1,1-difluoroethane (HCFC-142b), chlorodifluoromethane (HCFC-22), 1,1-dichloro-2,2,2-trifluoroethane (HCFC-123) and 1-chloro-1,2,2,2-tetrafluoroethane (HCFC-124), trichloromonofluoromethane (CFC-11), dichlorodifluoromethane (CFC-12), trichloro-trifluoroethane (CFC-113), dichlorotetrafluoroethane (CFC-114), chloroheptafluoropropane, dichlorohexafluoropropane, azodicarbonamide, azodiisobutyro-nitrile, benzenesulfonhydrazide, 4,4-oxybenzene sulfonyl-semicarbazide, p-toluene sulfonyl semi-carbazide, barium azodicarboxylate, N,N'-dimethyl-N,N'-dinitrosotere-phthalamide, trihydrazino triazine and mixtures of citric acid and sodium bicarbonate; and wherein said foam (either with or without elastification) has a dynamic modulus from about 100 to about 600 KPa, and a damping ratio of greater than about 12.

10. The acoustical insulation foam of Claim 9 wherein said alkenyl aromatic homopolymer or copolymer, Component (A), is derived from styrene, Component B is a substantially random interpolymer of ethylene and styrene, and the blowing agent, Component (E), is one or more of carbon dioxide, ethane, propane, n-butane, isobutane, n-pentane, isopentane, neopentane, cyclopentane, ethanol, 1,1-difluoroethane (HFC-152a), 1,1,1,2-tetrafluoroethane (HFC-134a), 1,1,2,2

tetrafluoroethane (HFC-134), ethyl chloride, 1-chloro-1,1-difluoroethane (HCFC-142b), or chlorodifluoromethane (HCFC-22).

11. The acoustical insulation foam of Claim 9, wherein said alkenyl aromatic
 5 homopolymer or copolymer, Component (A), is derived from styrene, in said substantially random interpolmer, Component B1(a) is styrene; and Component B2 is ethylene and at least one of propylene, 4-methyl-1-pentene, butene-1, hexene-1 or octene-1, and the blowing agent, Component (E), is one or more of carbon dioxide, ethane, propane, n-butane, isobutane, n-pentane, isopentane,
 10 neopentane, cyclopentane, ethanol, 1,1-difluoroethane (HFC-152a), 1,1,1,2-tetrafluoroethane (HFC-134a), 1,1,2,2 tetrafluoroethane (HFC-134), ethyl chloride, 1-chloro-1,1-difluoroethane (HCFC-142b), or chlorodifluoromethane (HCFC-22).
- 12 The foam of claim 7 having a multiplicity of channels extending from a surface
 15 into the foam, the channels being free of direction with respect to the longitudinal extension of the foam.
13. An improvement in a building construction wherein polymeric foam acoustical
 20 insulation is installed in a wall, ceiling or floor of said building construction, the improvement comprising using as said acoustical insulation a polymeric foam made from a polymer blend including
 - comprising;
 - (a) one or more alkenyl aromatic polymers, and
 - 25 b) one or more substantially random interpolymers.
14. In a floating flooring system comprising a structural subfloor and floating
 floor overlaid upon said subfloor, and a layer of a polymeric foam underlayment is installed between said structural subfloor and said floating floor, the improvement

wherein said polymeric foam is a cellular polymer blend including (a) at least one alkenyl aromatic polymer, and (b) at least one substantially random interpolymers.

15. Use as acoustical insulation in a building construction of a cellular polymer
5 blend including (a) at least one alkenyl aromatic polymer, and (b) at least one substantially random interpolymers.

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